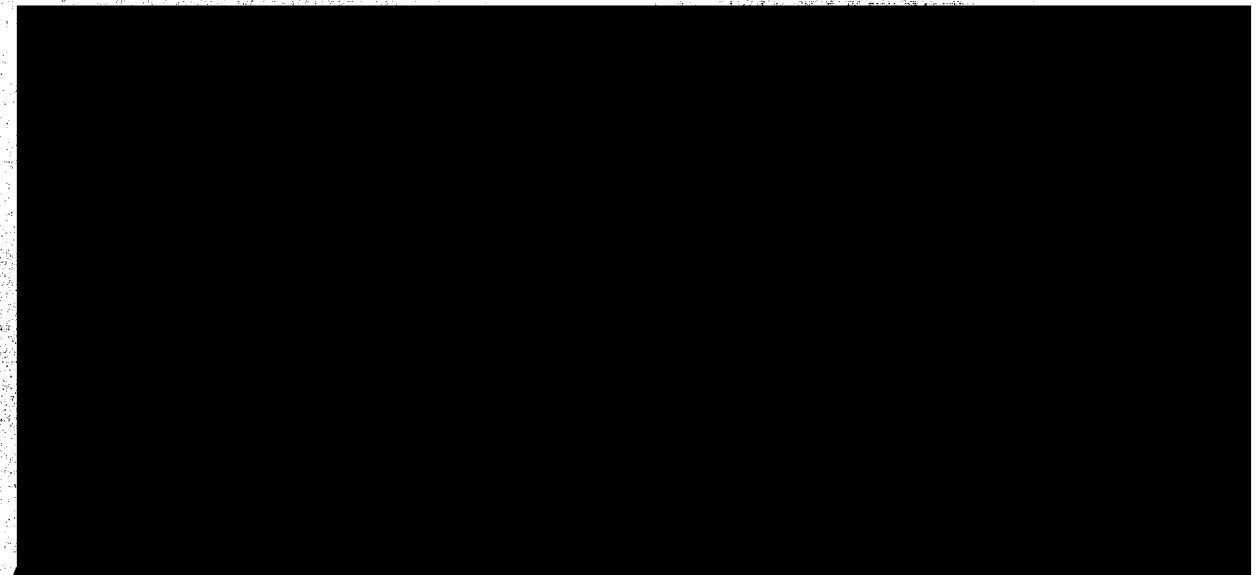


Declass Review by NIMA/DOD

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DIRECT IMAGE VIEWER  
FIRST QUARTERLY REPORT  
July 13 - October 13, 1964

Project 7506

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## II. ADMINISTRATIVE DETAILS

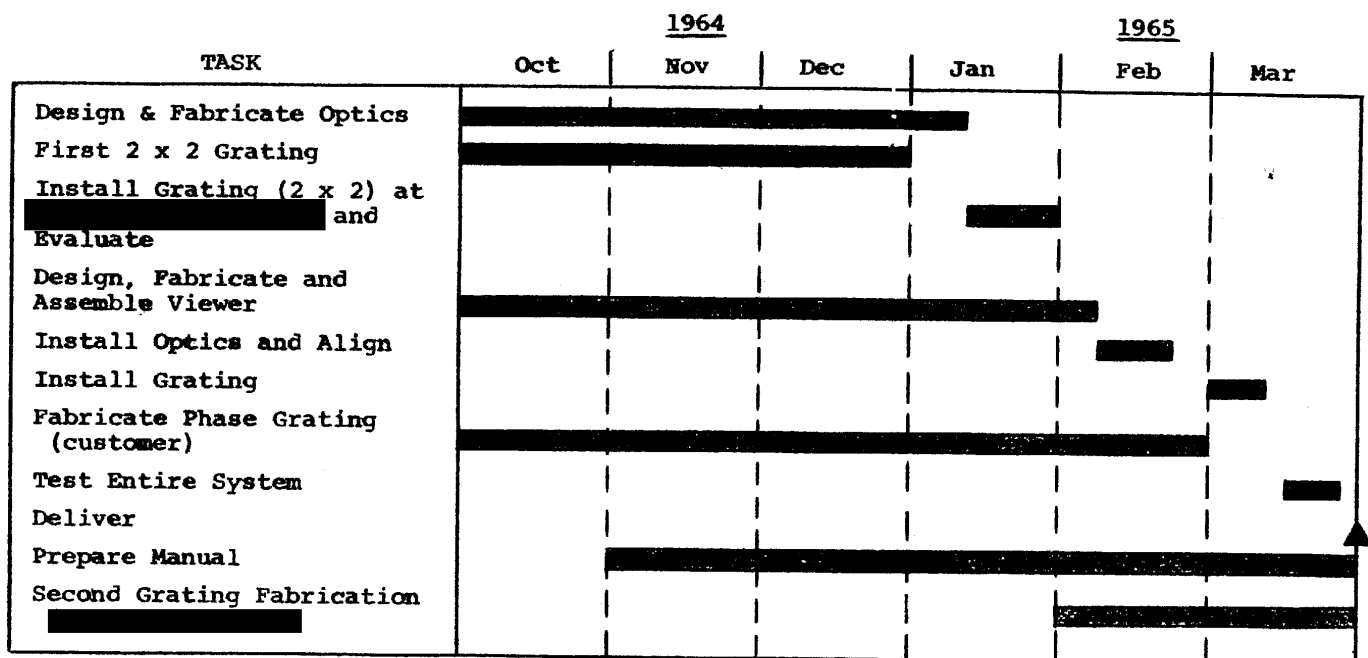
### A. Schedule

The schedule shown in Figure 1 shows a completion date based on the use of a phase grating supplied by the customer. If this does not work out and a 10 x 10 is produced by [REDACTED] STATOTHR after the second try the completion date would be extended about four months to the latter part of July. [REDACTED] has STATOTHR been late in their submission of optical technical data to [REDACTED] STATOTHR [REDACTED] At this time it looks as though it will not affect the schedule. STATOTHR

### B. Change of Scope Submission

During the latter part of this quarter a change of scope was submitted for evaluation and review. The technical justification covering this submission is included under Section IIIb.

This change of scope is an important aspect of this contract as it affects the two major areas of the viewer. The resulting submission will be known early next quarter.



PLANNED SCHEDULE FOR  
DIRECT IMAGE VIEWER

(Based on Customer's Grating)

Figure 1.

### III. TECHNICAL DISCUSSION

#### A. Progress

##### 1. Optics

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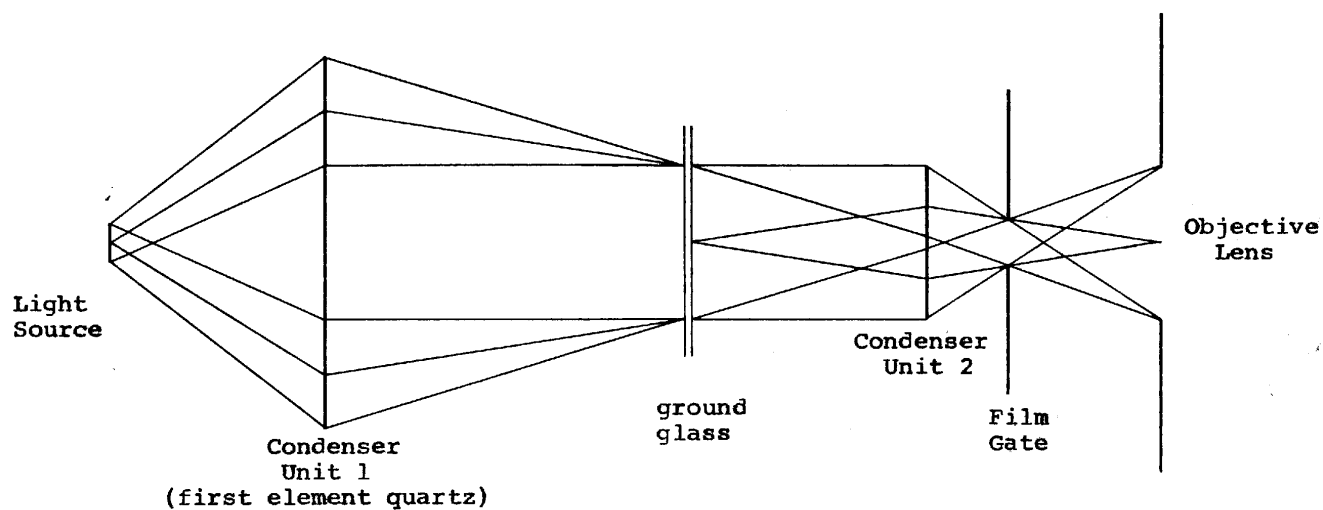
During the meeting at [REDACTED] on 13 July various optical/mechanical configurations were discussed for providing the dual magnification capability. The problem was again reviewed at a meeting of [REDACTED] on 19 and 20 August. The decision was made to use the dual path approach with two mirrors. On 26 August a letter was sent to the customer outlining the reasons for this optical configuration. Approval was given and the optical design proceeded along these lines.

One of the more difficult optical problems is the design of the condenser for the 50X case. This condenser system must pick up as large a cone as possible from the light source, then eliminate by reflection the IR portion of the spectrum, then filter the light to a narrow band and concentrate the light to evenly illuminate a .2 x .2 image, then spread it out in about one inch and fill the one inch aperture of the objective. The 5X case is made easier by the larger film format and greater distance between the film and lens. A preliminary sketch of the proposed 50X condenser system is shown in Figure 2.

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The other area given considerable thought is the light source required. [REDACTED] have performed intensity calculations. The calculations indicate that an 800-1000 watt Xenon arc lamp is required to present to the observer the same image brightness as he would see with 100 foot-lamberts and a diffusion screen. It is realized that certain assumptions have been made in these calculations. One is that a number of lumens in the green spectrum which equal those with white light give the same visual brightness response. Other assumptions have to do with overall optical transmission, grating efficiency and the distribution pattern of ground glass. Even with all these assumptions it is felt that the 1000 watt figure is sufficient for the job.

PRELIMINARY CONDENSER SYSTEM



50X CASE

Figure 2.

From investigations to date, a water cooled lamp looks like the most practical method. By using this method the heat produced by convection is almost eliminated. The lamps and cooling jackets are readily available. An auxiliary simple water cooling system packaged with the lamp power supply would be used.

## 2. Diffraction Grating

During the project kick-off meeting of 13 July it became evident that 13 instead of 9 diffraction orders were required. This was reported in the meeting minutes and reflected in the updated viewer specification. STATOTHR

Following the first meeting, [REDACTED] began Phase I. This consisted of a study program to investigate the various methods of grating fabrication to meet the illumination requirements STATOTHR over 13 orders. The final report was presented to all concerned on 24 October at [REDACTED]. Copies of their report were handed out to all parties present. A summary of their findings follow.

STATOTHR [REDACTED] investigated two methods of fabricating such a grating. The first technique, Roland ghosts, was rejected because of the multiple faceted groove shape along with the variation in spacing required to produce ghosts.

The second method which received the majority of effort was to use a standard line spacing, that is one which would diffract light at the proper angles with each consecutive order. The illumination intensity in each order would be controlled by special groove shaping. A computer was programmed to carry out calculations which predicts the expected transmission in each diffraction order for various groove shapes.

The first computer run was with 13 facets, one facet for each order. Other faceted computations were made from this down to four facets. Results were not satisfactory. Since cylindrical tools are generated in one step it was felt that this method was worth investigation. Radii were tried from 240 to 84.5 microns.

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These produced the most promising results. The optimum radius was 95 u. [REDACTED] then recommended that a spacing of 36.2 microns and a radius of 95 microns be used. This produces a groove depth of about 1.75 microns.

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[REDACTED] was then given approval to start Phase II, which consists of the cutting of a 2 x 2 master and fabrication of two replicas.

Figure 3 shows the computed intensity distribution across the 13 orders. The calculations indicated that the 1.4 factor between adjacent orders is not possible. It looks as though the 2:1 overall ratio is feasible.

### 3. Viewer Design

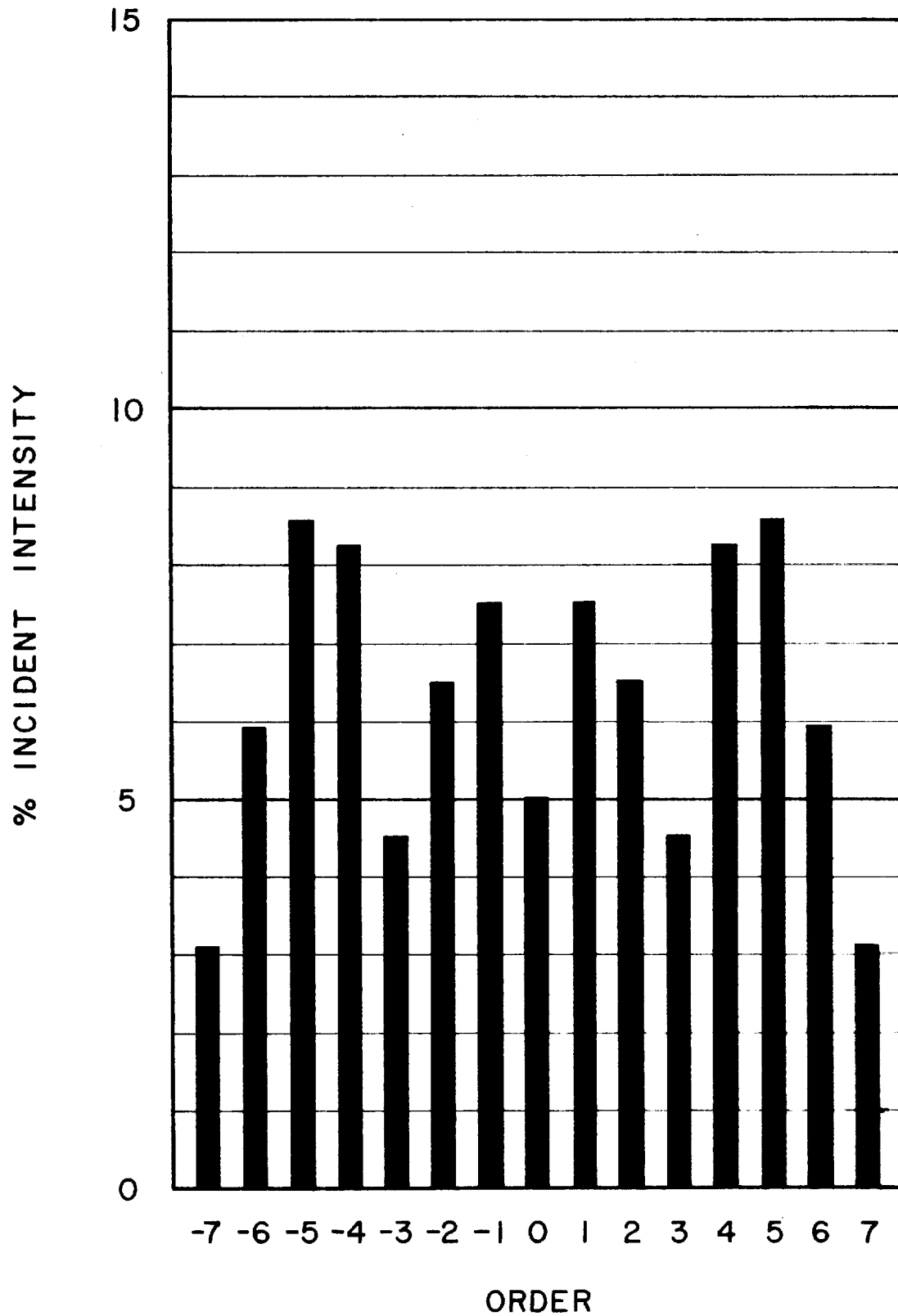
The basic viewer design was presented at the project meeting on 13 July. Listed below are some of the discussion results which affect the viewer mechanical design.

- a. The viewer will accommodate 4 x 5 and 70mm film chips.
- b. The light source mid band was selected as 5086A.
- c. A Xenon arc would be used as the light source.
- d. Since the lamp intensity cannot be varied an auxiliary optical/mechanical device is required to reduce the illumination following on the film.
- e. Depending upon the cooling of the light source the film might require cooling to keep the emulsion temperature under 95°F.
- f. A separate package would contain the lamp power supply.

Many of these items cause a change of scope to the basic viewer plans. This situation is discussed in Section B of this

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RADIUS 95.0  $\mu$



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report. As stated in the 13 July meeting, [REDACTED] can only perform limited design work until the optical configuration is laid out and mounting drawings provided.

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On 19 and 20 August the [REDACTED] project engineers met at [REDACTED] and reviewed the INTL optical system layout. Certain items were fixed so that initial mechanical design could begin. Dates were set at this time for the delivery of drawings to [REDACTED] covering the optical components. All of the drawings have not yet been received by [REDACTED]. But the earlier decisions made allowed [REDACTED] to design the X-Y translation and platen mechanisms. The design is complete and detailing has begun.

#### B. Change of Scope

Two main subsystems have undergone considerable change since the program was initiated. These are the light source and X-Y translation and platen mechanism.

##### 1. Light Source

The illumination calculations indicated that a 1000 watt Xenon arc lamp was required. A lamp of this type requires a large current power supply. This type of lamp cannot be varied over a 10:1 brightness range which is desirable for the viewer. Therefore, a continually variable network density wedge is required for this task. This entire system along with the water cooling planned is a significant change over the initial plans. It was not possible at the proposal stage to realize the intensity required and therefore a less complicated system was initially planned.

##### 2. X-Y Mechanism

When an F/1 lens is used at 50X in order to view 200 l/mm or more the depth of focus is very small. This adds complexity to the system as the film size grows and the dual magnification is added. At the time of the proposal addition to a dual magnification viewer, only a 70mm film size was considered. Since this time a 4x5 film chip capability was added.

During discussion at the 13 July meeting various vacuum hold-down systems were discussed. The customer proposed that instead of a groove to hold down a 2" square the use of a manifold which would hold the entire film flat. When using this method it is then required to move the film 4" in either direction rather than the previously planned 2". This greater movement along with the larger size and the shallow depth of focus requires a more complex film support and X-Y translation mechanism.

The light source is required as well as the two film sizes and the X-Y four inch movement along with the vacuum manifold hold-down is considered desirable by the customer.

C. Trips STATOTHR STATOTHR

1. [REDACTED] conducted a project kickoff meeting at [REDACTED] on 13 July.
2. [REDACTED] spent August 19 and 20 at [REDACTED] STATOTHR [REDACTED] in discussing and laying out the optical configuration.
3. [REDACTED] attended the Phase I review meeting at [REDACTED] on 24 October.

D. Work Planned for Next Period

1. Optics - The fabrication of the optical elements for the first system will be completed. The optical system will be in the process of being aligned for acceptance of the first try 2 x 2 grating.
2. Diffraction Grating - The grating will be completed and await installation in the optical system.
3. Viewer - The design and fabrication will be completed and sub-assembly started. Early in the next period the viewer will undergo final assembly.